TECHNICAL NOTES
U.S. DEPARTMENT OF AGRICULTURE NEVADA SOIL CONSERVATION SERVICE

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STANDARD METHODS OF MEASURING CROP VEGETATION RESIDUES, YIELDS

As greater emphasis is placed on conservation tillage, crop residue use and stubble mulching in soil erosion control systems, soil conservationists need to have available acceptable methods for measuring and estimating amounts of crop residues. This technical note contains instructions on the commonly used methods of measuring and estimating crop residues. Its objective is to encourage improved sampling procedures and accuracy in crop residue measurements.

The Hand Clipping Method

This method consists of hand clipping and weighing crop residues. It requires a fixed guide consisting of a square or ring containing 9.6 square feet inside the frame. A square with 37.2 inches per side or a ring having a 42-inch inside diameter is used to get a 9.6 square feet template. Measurements are made in grams for easy conversion to pounds per acre. To use, place the ring or square on the ground and collect all visible parts of plant vegetation or residue above the ground within the ring or square. Clip off all attached or partially buried vegetation at the soil surface. Materials such as weeds should be included when the sample is for erosion control purposes. When the sample area contains small pieces of vegetation that are difficult to pick up, the soil conservationist should estimate the amount (in grams) remaining on the soil surface. Do not include soil particles in the sample.

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Weigh all samples in an air-dry condition. When samples are wet, they should be air-dried under natural weather conditions or oven-dried at approximately 70° C. until the weight has become stable. Use a gram scale to weigh the sample. To convert the sample weight to pounds per acre, multiply the sample gram weight by 10.

A minimum of four samples per field should be collected using a random method of sampling. When the field contains chaff or straw rows, one of the four samples should include the chaff row.

The Line and Point Method

This method requires crop residues to be flattened and uniformly distributed across the field.

The line consists of a chord 50 feet long with 100 knots or beads spaced 6 inches apart. Lines can be easily made from a piece of 1/8 or 3/16 inch nylon rope about 70 feet long and two metal pegs or stakes. Overhand knots are tied in the rope on 6 inch centers. The end product is a 50 foot chord with 100 points on it. The two metal pegs are attached to the ends of the rope. They are used to stake the line out.

In the field the line is stretched out across the field at an angle about 45 degree to the crop rows. Both end pegs are pushed into the soil to hold the line straight.

To estimate residue on the soil walk along the line and count the number of knots that lie on top of a piece of crop residue. Ignore small pieces of residue that will decay before the critical erosion period, or are not large enough to intercept a raindrop. The number of knots directly over residue will tell the percentage of the surface covered with residue. Tables 1 and 2 can be used to convert percent cover to lbs. of cover per acre.

To improve accuracy three or more randomly selected samples should be taken and results averaged.

The Weight Estimate System

The weight estimate system is similar to the hand clipping method. It is faster but less accurate, however, it is accurate enough for planning purposes.

This system uses a 9.6 square foot or ring. The square or ring is placed on the ground. Then the soil conservationist selects a handful of the same type of material located outside the square or ring. This sample should be large enough to weigh, but not too much to easily handle in one hand. Holding the sample in one hand, the soil conservationist uses the other hand to estimate the number of "like handfuls" of residue contained within the square or ring by grasping handfuls inside the template. The hand sample is then weighed in grams and the weight multiplied by the number of "like handfuls" to determine the estimated weight of the residues within the square or ring. The weight in grams is multiplied by 10 to give pounds per acre.

This procedure should be randomly repeated over the field to get a proper representation of the field. Weight estimates should periodically be checked against actual clipping weights to maintain accuracy.

Row-Length Method

Where row crops are grown, it is often desirable to use the row-length method to measure residue. This is accomplished by measuring the row spacing and marking off the row length required to give the proper size sample. The sample area should be a minimum of 1 square yard for small grains and grasses and a minimum of 2 square yards for corn. The following table is used to determine row length needed when the row spacing is known.

Row spacing center-to-center	Length of row to make 2 square yards	Length of row to make 1 square yard
Inches	Feet	Feet
20	11	5.5
24	9	4.5
30	7	3.5
36	7	3.0
42	5	2.5

All above ground vegetation or residue is collected and weighed. Samples are weighed air-dry. Sufficient samples should be measured to get a good representation of the field. Sample weights are averaged to gain the weight of the average 1 square yard sample. When the weight is in grams, multiply average sample weight by 10.66 to convert to pounds per acre.

Rod Row Sampling

This method consists of cutting a measured length of drill row and weighing the grain or straw yield. Any length of row can be cut, but, the following row lengths are recommended because they produce an easily-managed bundle or sheath and the data is easily converted to pounds or bushels per acre.

1. On 14-inch drill spacing - Cut two adjacent rows in a 9-foot 4-inch length. To convert yield to lbs. per acre, multiply by 2000.

2. On a 7-inch drill row spacing - Cut two adjacent rows 9 feet 4 inches long. To convert yield to lbs. per acre, multiply results by 4000.

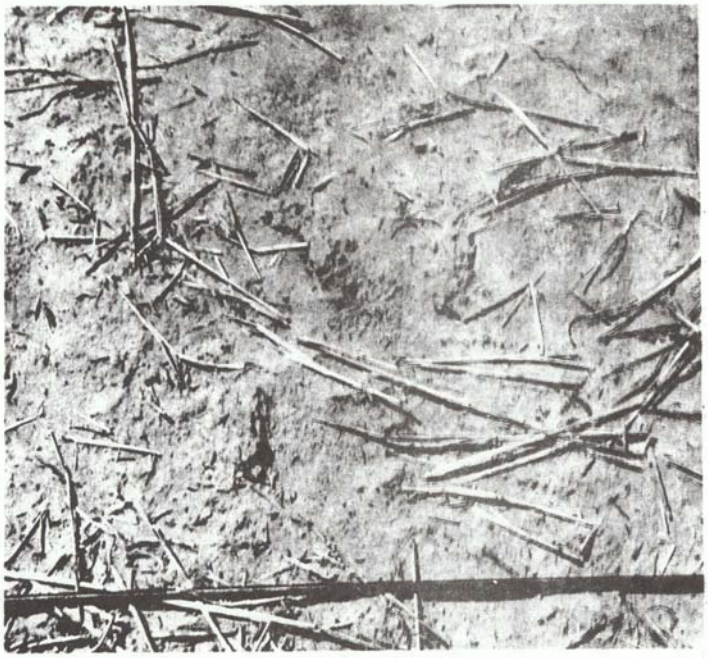
3. On a 6-inch drill row spacing - Cut two adjacent rows 8 feet 8½ inches long. To convert yield to lbs. per acre, multiply results by 5000.

Cutting two adjacent drill rows is better than cutting only a single row because drill skips in the row are usually compensated by heavier tillering in the adjacent row.

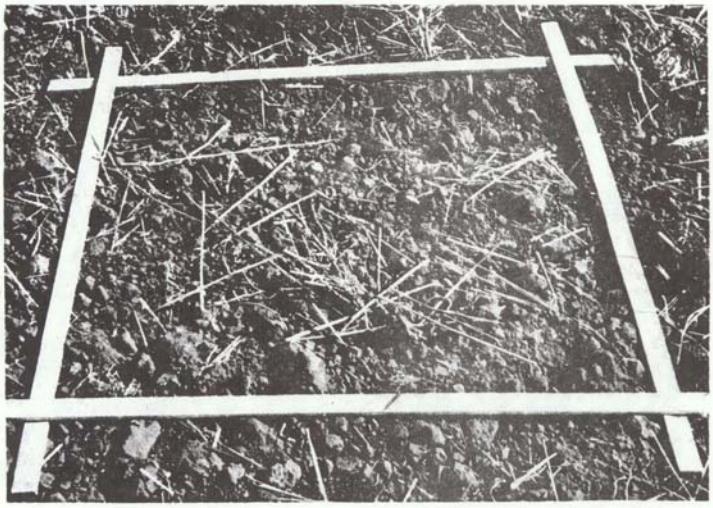
Photo Comparisons

Photographs of different amounts of crop residue can be compared to field situations to estimate the amount of crop residues on the field. This method is accurate enough for general planning purposes, but should not be used for certifying practice compliance. Soil conservationists using photo-comparison should frequently check themselves by clipping samples using the square or ring method to maintain accuracy at a high level.

The attached photographs can be used for making photo camparisons.



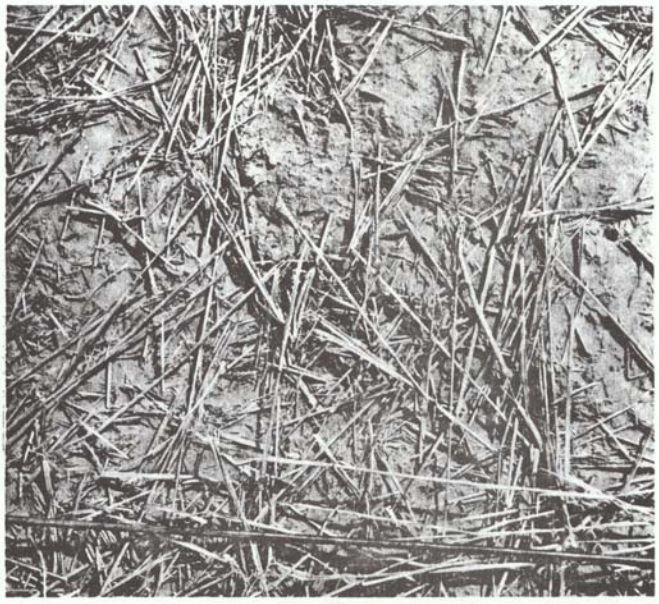
R = 300 lbs. /acre



R = 500 lbs. /acre

A guide for estimating amounts of anchored wheat residue (R) in lbs. per acre (Air-dry).

R = 750 lbs./acre



R = 900 lbs./acre

A guide for estimating amounts of anchored wheat residue (R) in lbs. per acre (Air-dry).

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R = 1,100 lbs. /acre

R = 1,250 lbs. /acre

A guide for estimating amounts of anchored wheat residue (R) in lbs. per acre (Air-dry).

R = 1,400 lbs./acre

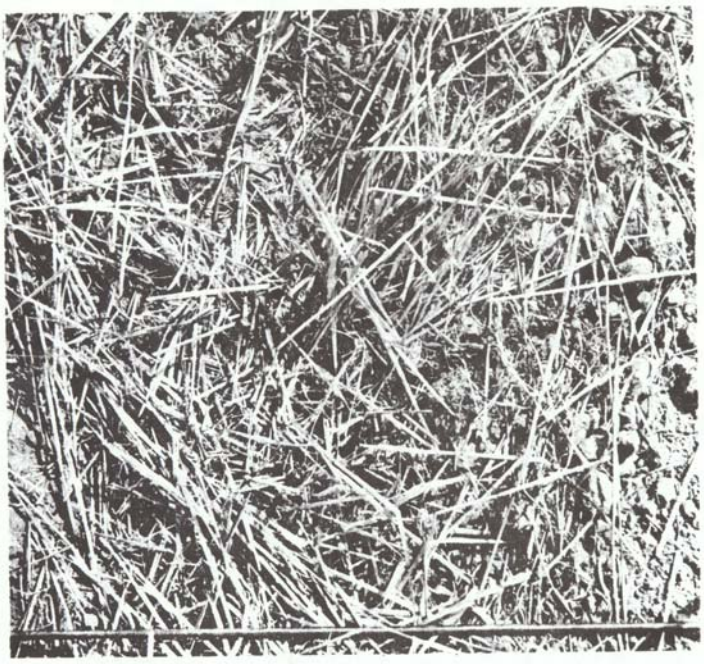
R = 1,500 lbs./acre

A guide for estimating amounts of anchored wheat residue (R) in lbs. per acre (Air-dry).

R = 1,700 lbs./acre

R = 2,000 lbs./acre 5,L-20,287.56

A guide for estimating amounts of anchored wheat residue (R) in lbs. per acre (Air-dry).

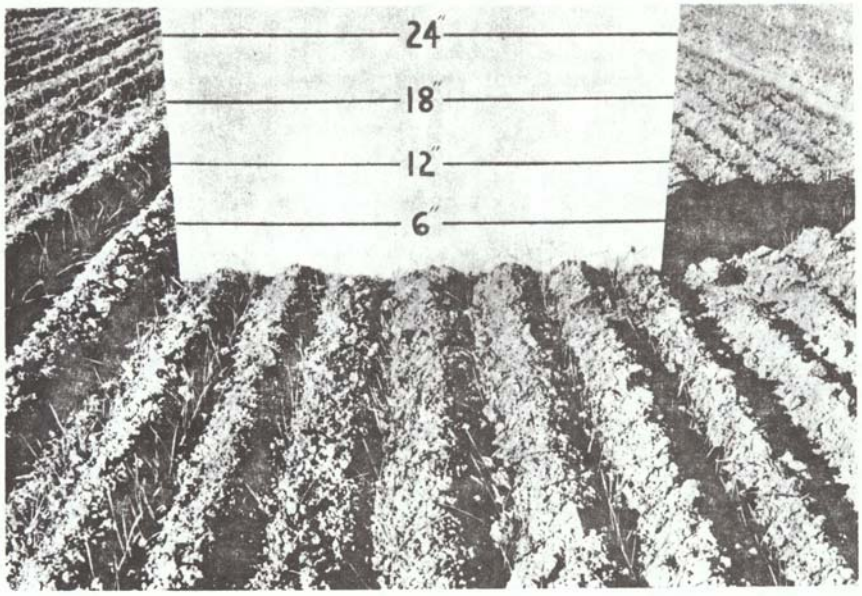


R = 2,500 lbs./acre

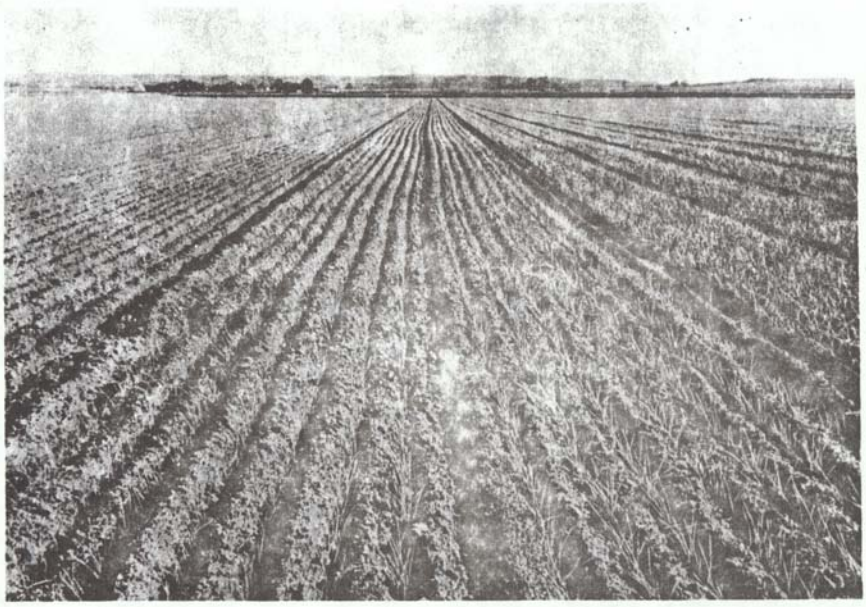
R = 3,000 lbs./acre

5,L-20,287.57

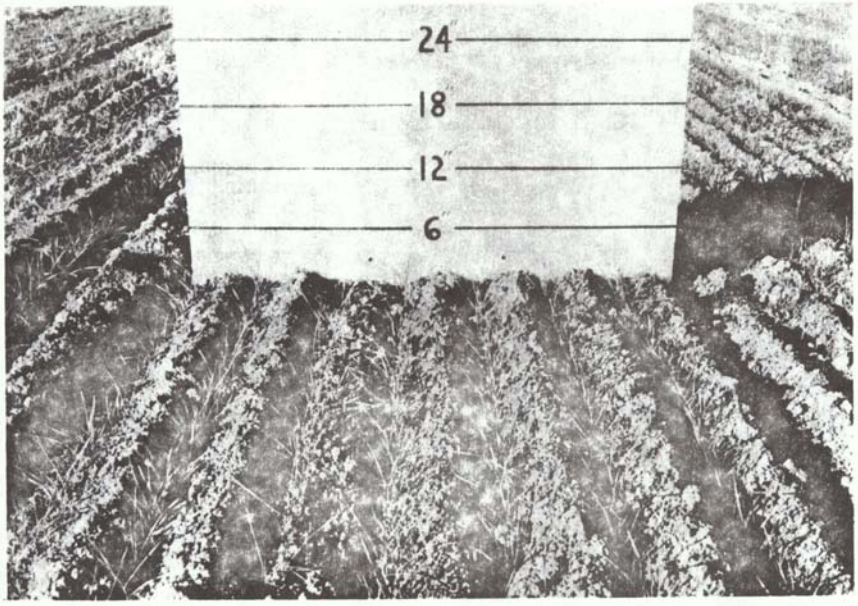
A guide for estimating amounts of anchored wheat residue (R) in lbs. per acre (Air-dry).



Seven days after emergence, air-dry weight is 31 lbs./acre. Wheat in the one to two leaf stage, about 5 inches tall from bottom of furrow. Growth is erect. The above is a close-up view of the field below.



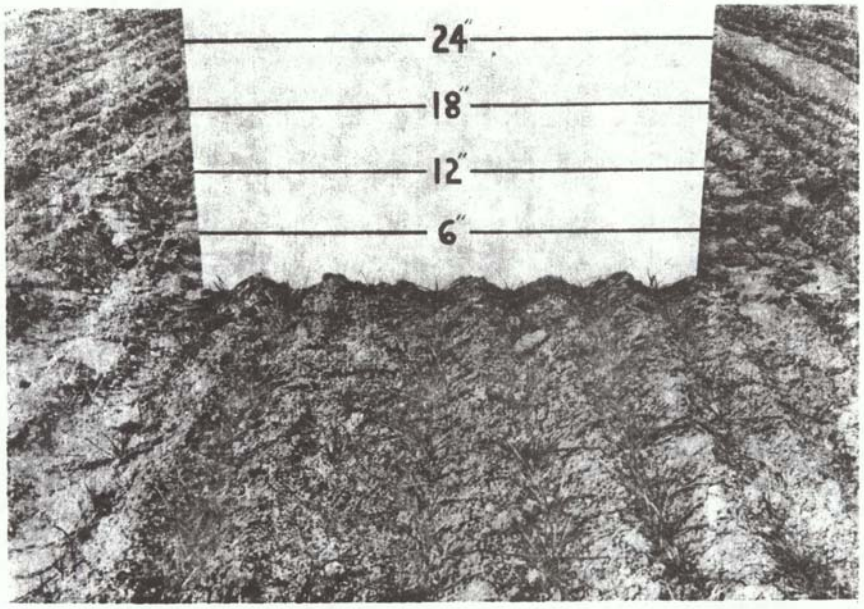
A guide for estimating pounds of wheat per acre in the development stage (seedling and stooling stages) on an air-dry basis--winter wheat. 5,L-20,287.58



Fourteen days after emergence, air-dry weight is 74 lbs./acre. Each plant in the 2-3 leaf stage and erect. Additional weight compared to previous pair of photos due to tillering as leaf lengths are still about 5 inches. The above is a close-up view of the field below.

A guide for estimating pounds of wheat per acre in the development stage (seedling and stooling

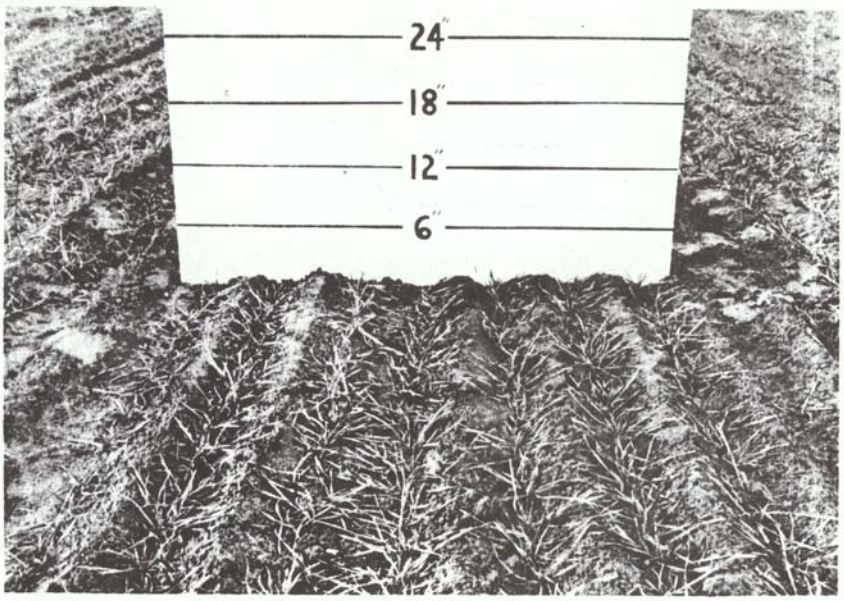
5,L-20,287.59



Twenty-two days after emergence, air-dry weight is 124 lbs./acre. Leaves less erect, increase in weight due entirely to stooling, no increase in length of leaves. The above is a close-up view of the field below.

A guide for estimating pounds of wheat per acre in the development stage (seedling and stooling stages) on an air-dry basis--winter wheat

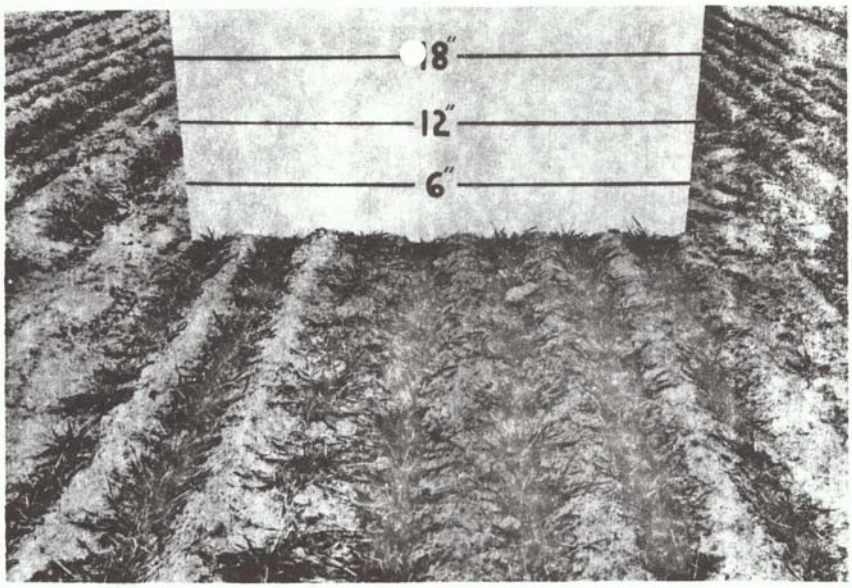
5,L-20,287.60



Thirty-five days after emergence, air-dry weight is 257 lbs./acre. Well stooled with leaves mostly prostrate. The above is a close-up view of the field below.

A guide for estimating pounds of wheat per acre in the development stage

5,L-20,287.61



Fifty-six days after emergence, air-dry weight is 399 lbs./acre. Growth completely prostrate. The above is a close-up view of the field below.

A guide for estimating pounds of wheat per acre in the development stage (seedling and stooling stages) on an air-dry basis--winter wheat.

5,L-20,287.62

TABLE 1

COVER/RESIDUE TABLE FOR WHEAT, BARLEY, OATS, SOYBEANS,
OR SIMILAR SMALL DIAMETER STALK

PERCENT COVER	LBS OF RESIDUE/ACRE	PERCENT COVER	LBS OF RESIDUE/ACRE
1	16	51	1107
2	31	52	1139
3	47	53	1172
4	63	54	1205
5	80	55	1239
6	96	56	1274
7	113	57	1310
8	129	58	1346
9	146	59	1384
10	164	60	1422
11	181	61	1461
12	198	62	1502
13	216	63	1543
14	234	64	1586
15	252	65	1629
16	271	66	1674
17	289	67	1721
18	308	68	1768
19	327	69	1818
20	346	70	1868
21	366	71	1921
22	386	72	1976
23	406	73	2032
24	426	74	2091
25	446	75	2151
26	467	76	2215
27	488	77	2281
28	510	78	2350
29	532	79	2422
30	554	80	2498
31	576	81	2577
32	599	82	2661
33	622	83	2750
34	645	84	2844
35	669	85	2944
36	693	86	3051
37	717	87	3166
38	742	88	3291
39	767	89	3426
40	793	90	3573
41	819	91	3737
42	845	92	3920
43	872	93	4127
44	900	94	4366
45	928	95	4649
46	956	96	4995
47	985	97	5442
48	1015	98	6071
49	1045	99	7147
50	1076	100	9999

TABLE II

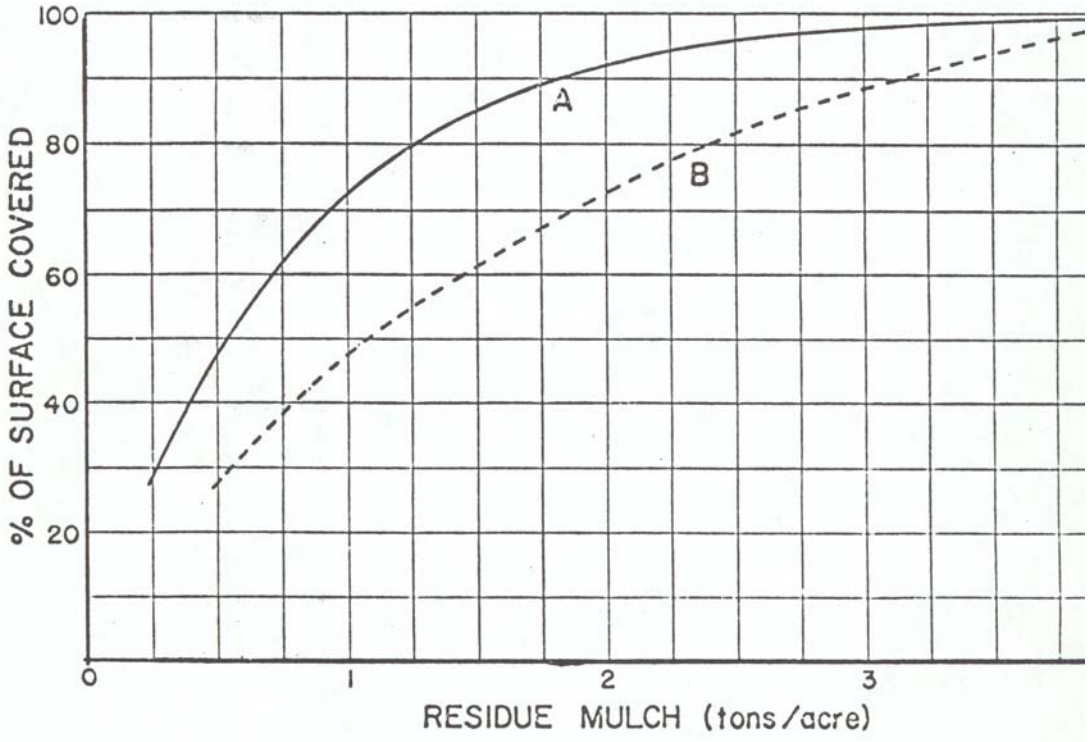


Figure 2. Relation of percentage of surface cover to mulch rate. Curve A is for small-grain curve B is for chopped cornstalks.*

Acknowledgements

This material was developed from the following references:

"A Standardized Procedure for Residue Sampling" - USDA-ARS 41-68.

"Methods of Measuring or Estimating Amounts of Crop Residue Per Acre" WTSC Agronomy Note NO. 23, November 1965 by J.W. Turelle.

"Weight-Estimate System of Sampling Crop Residues" (unpublished) by Evan L. Murray.

"Predicting Rainfall Erosion Losses, A Guide to Conservation Planning," USDA Handbook No. 537, prepared by Science and Education Administration (ARS), 1978.

Plant Science Handbook, Washington State University.

"Measuring Crop Residue Cover", Laflen, J.M. etol, Journal of Soil and Water Conservation, November-December 1981.